RYANIA AND PEARSLUG CONTROL ON NASHI

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SUMMARY

Ryania (Ryan-50) was evaluated for the control of pearslug, *Caliroa cerasi*, on nashi in Central Otago in 1990-91 and 1991-92. Ryania was highly toxic to larvae and caused more than 90% mortality when used at rates of 300 g/100 litres or 600 g/100 litres Ryan-50. A fortnightly schedule of Ryan-50 sprays at 600g/100 litres for codling moth control protected nashi from pearslug damage, with no evidence of larval survival beyond the first or second instar.

Keywords: pearslug, nashi, ryania, organic production, *Bacillus thuringiensis*.

INTRODUCTION

In a survey of organic pip-fruit growers in 1990 (Wearing and Walker 1990), the pearslug was identified as the most important problem pest of European pears and nashi. This insect damages the foliage of pears, cherries, plums, and rowans. Organic summerfruit growers experience severe damage to the foliage of plum and cherry trees, and some ornamental trees of the genus *Sorbus* are highly susceptible (e.g. *Sorbus* aria). The biological control and bivoltine life cycle of pearslug were reviewed by Hill and Valentine (1989). Pearslug overwinters as a final larval stage (or eonymph) and adults emerge in late spring. Damage is caused by the larval stage feeding on the leaf surface and creating "windows". There are seven larval instars. Mature larvae drop or crawl to the ground and spin silken cocoons. Damage is inflicted primarily by the second generation in late summer and natural enemies in New Zealand are inadequate to prevent this.

There have been recent efforts to find an effective control for pearslug compatible with organic production. Van Epenhuijsen and Carpenter (1990) reported that natural pyrethrin and Liquid Derris (rotenone) reduced pearslug numbers; the efficacy of pyrethrin, with or without garlic extract in various formulations, was confirmed by van Epenhuijsen and de Silva (1991). However, they reported poor control with Liquid Derris. The toxicity of ryania to pearslug was first reported by Wearing (1991). Ryania is a plant-derived insecticide which is toxic to a number of fruit pests and is selective for the survival of many natural enemies (Wearing 1990). Although once used commercially in New Zealand (Ryanicide), no current formulation is registered here. Van Epenhuijsen and de Silva (1991) recorded high mortality of pearslug following treatment with 0.8% Naturgro R-50 (containing 0.11% ryanodine) but lower mortality with 1.25% Naturgro Triple plus (containing 0.055% ryanodine, 0.1% pyrethrins, 0.75% rotenone).

Ryan-50 is a new formulation of ryania containing 0.10% ryanodine (Dunhill Chemical Company, California, U.S.A.) and it was evaluated for the control of pearslug in Central Otago.

MATERIALS AND METHODS

The trials were conducted on a 1.75 ha block of mixed nashi cultivars (planted 1982-88) at the DSIR Research Orchard, Clyde in 1990-91 and 1991-92. With the exception of agrimycin for fireblight control, the block received no conventional pesticide sprays.

1990-91 trial

The trial began on 14 February 1991 with a pre-treatment count of pearslug larvae on 16 half-trees (replicates). Five extension shoots per half tree (east, west) were labelled and examined carefully leaf by leaf for the numbers of larvae in each of four

size classes. This pre-treatment count of larvae per shoot was completed on 15 February and four half-trees (cvs. 'Shinsui' and 'Shinseikki') were allocated at random to each of four treatments: 1 untreated 'control'; 2 Ryan-50 150g/100 litres (0.15%); 3 Ryan-50 300g/100 litres (0.3%); 4 Ryan-50 600g/100 litres (0.6%). A single spray of Ryan-50 was applied to run-off to all treatments on 16 February using a Solo knapsack sprayer. Conditions for spraying were excellent with no wind or rain.

Post-treatment counts on the labelled extension shoots were made 3 and 10 days after treatment. The same methods of recording were used as in the pre-treatment counts, except that, in addition, larvae were recorded as alive, dead or moribund. This was determined by stimulating the larvae with a brush. Moribund larvae were re-checked within 24 hours and classified as alive or dead.

At the time of the pre-treatment count, some larvae were in their final or penultimate instars (largest size class). By the time of the last assessment, some of these larvae had probably pupated, because in this experiment it was possible to follow the progress of many of the individual larvae. Estimates of pupation were used to provide a "corrected" mortality for analysis. However, this was only a supplement to the mortality estimated from the differences between pre- and post-treatment counts and the untreated'control'.

Analysis of variance (Hintze 1988) was used to determine the effect of the treatments on the following: Post-treatment counts 1 and 2 (per replicate): Numbers of live larvae, numbers of dead larvae, percentage mortality estimated by comparison with pre-treatment count (arc-sin transformed).

Post-treatment count 2: Percentage mortality "corrected" for pupation (arc-sin transformed).

1991-92 trial

This trial evaluated ryania and *Bacillus thuringiensis* (Thuricide) for the control of various insect pests. To control codling moth, Ryan-50 at 0.6%, with or without Thuricide at 0.1%, was applied fortnightly (see Table 2). Application was by hand to run-off to individual trees using a tractor-drawn sprayer operating at 1000 kpa and 8-10 litres per tree. These treatments were compared with Thuricide alone and an unsprayed control treatment. The effects of the four treatments on pearslug were evaluated from 4 to 9 March 1992 by examining 10 extension shoots per tree (five on the west side, five on the east side) and recording the numbers of leaves per shoot, the numbers of leaves damaged by pearslug (grades 1 and 2), and the numbers of live pearslug larvae present. Grade 1 damage was very minor (pin-prick) feeding by first (and possibly second) instar larvae without the formation of the characteristic 'windows'. Grade 2 was more extensive damage with 'window' formation. There were five replicates (trees) per treatment using four cultivars ('Hosui' (2), 'Kosui', 'Nijiseikki', 'Shinseikki').

The results were analysed by ANOVA (Hintze 1988). Damage in the two grades was converted to percentages for each shoot and then transformed before analysis. Means were compared using Duncan's Multiple Range Test.

RESULTS

Analysis of variance showed that the effects of Ryan-50 on the survival of pearslug in the 1990-91 trial was highly significant ($P<0.001$), using a variety of parameters (Table 1). Numbers of dead larvae were sufficient for analysis only in the first count after treatment.

Ryan-50 at 0.6% caused more than 90% mortality of the larvae within 3 days of treatment. This mortality had not increased significantly by the tenth day. The Ryan-50 at 0.3% showed a level of toxicity similar to that at 0.6%, and this was significantly greater after 10 days than that caused by 0.15% Ryan-50. A regression of mortality against dosage rate was highly significant ($P<0.01$) showing that the effect of Ryan-50 on pearslug is rate-dependent. However, further research with a greater number of concentrations is needed to clarify this relationship. The results suggest that Ryan-50 at 0.3 to 0.6% should provide control of pearslug on nashi.

TABLE 1: Mean numbers and mortality of pearslug larvae on five extension shoots of nashi after treatment with Ryan-50 at three rates on 16 February 1991. Mean values not followed by the same letter are significantly different at P<0.05. Percentages were arc-sin transformed for analysis.

Ryan-50 g/100 litres	No.live larvae 19.2.91	No.live larvae 26.2.91	No.dead larvae 19.2.91
Untreated	26.75a	22.00a	1.00a
150	9.75b	5.50b	8.75ab
300	4.00bc	1.25b	9.75ab
600	2.00c	1.00b	15.00
	% mortality	% mortality	"Corrected" mortality#
	19.2.91	26.2.91	26.2.91
Untreated	-1.18a*	16.71a	-3.47a*
150	67.21b	81.13b	68.33b
300	84.70bc	96.85c	89.12c
600	91.90c	93.92c	92.57c

* negative values indicate small population increase
\# corrected for pupation

TABLE 2: Effects of Ryan-50 and Thuricide on the percentage of nashi leaves damaged by pearslug and the numbers of live pearslug larvae present per extension shoot in March 1992. Figures in the same column and not followed by the same letter are significantly different (P<0.001).

Treatment#	Rate g/100 litres	% leaves damaged* Grade 1	Grade 2	No. arvae
Thuricide	100	21.74b	37.89b	0.22a
Ryan-50	600	32.78c	0.78a	0.06a
Ryan-50 + Thuricide	600 + 100	33.52c	0.75a	0.06a
Untreated	-	5.72a	69.24c	3.92b

* Percentages were arc-sin transformed for analysis.
\# Sprays were applied 19.11.91, 1.12., 16.12., 30.12., 14.1.92., 27.1., 10.2., 25.2.

The results of the 1991-92 trial using 0.6% Ryan-50 are summarised in Table 2. There was no significant difference between samples from the east and west sides of the trees. Ryan-50 reduced grade 2 damage (P<0.001) compared to that in both the untreated control and the Thuricide treatments. Thuricide also reduced grade 2 damage compared to that of the untreated control (P<0.001). These accumulated seasonal damage data were consistent with the counts of live larvae at the time of sampling, although the numbers of larvae in the Thuricide treatment were not statistically different from those in the two Ryan-50 treatments.

The Ryan-50 treatments did not entirely prevent leaf damage. The percentages of leaves with grade 1 damage were higher (P<0.001) in these treatments than in the untreated control or Thuricide treatments. Similarly, the percentage of leaves with grade 1 damage was higher in the Thuricide treatment than in the untreated control. These results reflect the differences between treatments in the survival of larvae to later instars (grade 2 damage). Most larvae in the untreated control survived to cause grade 2 damage. In contrast, the Ryan-50 treatments reduced the overall leaf damage from 75% to 34% (P<0.001) and almost all this damage was in grade 1.

DISCUSSION

The 1990-91 trial clearly demonstrated the toxicity of Ryan-50 to pearslug and showed that this was rate-dependent. The data suggested that Ryan-50 at 0.3% killed the larvae more slowly than did 0.6%. Nevertheless, foliage damage by the larvae after spraying was observed to be minimal at both rates, and timed applications of 0.3% Ryan-50 would appear sufficient for control. Further research, similar to that of van Epenhuijsen and de Silva (1991), would be required to determine the optimum times and thresholds for spraying against the first and second generations of pearslug in different regions.

In the 1991-92 trial, Ryan-50 was used at 0.6% because the target pests were both pearslug and codling moth (Wearing 1990). The fortnightly programme of sprays was applied during the flight period of codling moth (mid Nov. - late Feb.) and the foliage sampling showed that excellent control of pearslug was achieved. The numbers of surviving larvae per shoot (0.06, 19 leaves/shoot) was well below the tentative economic threshold of 0.25 larvae/leaf proposed by van Epenhuijsen and de Silva (1991). Moreover, all the surviving larvae were in the first instar, indicating (when considered with the damage data) that Ryan-50 effectively prevented further development. Ryania acts principally as a stomach poison and is slow acting compared to conventional insecticides (Wearing 1990). Minor non-economic feeding damage from young larvae occurred in the presence of the regular schedule of Ryan-50 sprays.

A similar schedule of Thuricide sprays at 100 g/100 litres also significantly reduced damage to nashi from pearslug, but less effectively than Ryan-50. The Thuricide was even slower acting than the Ryan-50, as shown by the greater grade 2 damage in the Thuricide treatment (Table 2). Van Epenhuijsen and Carpenter (1990) did not obtain significant mortality of pearslug for up to 6 days after treatment with Thuricide plus Naturoil. The slow action of Thuricide may require longer periods for assessment, and control with Thuricide may not be adequate under conditions of fewer sprays and high population pressure.

At the rate of Ryan-50 used, the addition of Thuricide to Ryan-50 did not significantly improve control. However, a spray programme designed for codling moth and leafroller control which combines Ryan-50 and Thuricide could be expected to provide effective pearslug control.

Control of codling moth with six sprays of ryania per season was estimated by Wearing (1990) to cost $1110 per hectare on apples, with concurrent control of Froggatt's apple leafhopper, *Typhlocyba froggatti*. The control of pearslug on pears similarly, will improve the economics of using ryania for pest control on organic pears.

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